CONTENTS

7. CUMULATIVE EFFECTS

Implementing regulations for the ESA define "cumulative effects" as those effects caused by future projects and activities unrelated to the action under consideration (not including discretionary federal actions) that are reasonably certain to occur within the action area (50 CFR 402.02). Since all future discretionary federal actions will at some point be subject to consultation under Section 7 of the ESA, their effects will be considered at that time and are not included in an assessment of cumulative effects. This includes activities such as timber harvest on National Forest Land.

Because of the large scale and scope of the Willamette Project, and the indirect effects that occur throughout the Willamette River basin as a result of flood control and other authorized and incidental purposes, it is difficult to distinguish between the many actions that are indirectly related to the project from those that are unrelated. This section therefore simply summarizes all actions not directly related to the construction and operation of the Willamette Project and considers them to have cumulative effects on listed species that may occur above and beyond effects directly related to the Project. The majority of the following actions and effects can be expected to increase in frequency, magnitude, and/or duration as human populations and other land and water uses increase within the basin. Hence, the cumulative effects of the actions described below are likely to exacerbate any adverse effects that the Willamette Project may have on listed species. Many of the activities and effects identified have existed for a long time (e.g., see Thompson et al. 1966).

7.1 NON-FEDERAL ACTIVITIES AND CUMULATIVE EFFECTS INFLUENCING LISTED SPECIES IN THE MAINSTEM WILLAMETTE RIVER

Increasing urbanization has either eliminated or adversely affected habitat for listed species throughout the Willamette River basin (PNERC 1998). Effects are greatest for the listed species living and reproducing below Willamette Falls, where urbanization has been most extensive. Oregon’s three largest population centers, Portland, Salem, and Eugene-Springfield are located along the mainstem Willamette River and account for more than two-thirds of the state's total population (PNERC 1998). With respect to fish habitat, urbanization has resulted in increased point and non-point source water pollution, increased peak flows, reduced base flows, channel erosion, landslides, channelization, and reduced habitat complexity and availability. Increased population density leads to increased legal and illegal harvest and harassment of listed species.

Before the implementation of wastewater treatment regulations in the 1970s, sewage and industrial discharges in the mainstem Willamette River caused severe water quality problems. Control of the major point sources of pollution has resulted in improvements to the water quality of the river. However, low oxygen conditions, and nitrogen and phosphorous pollution persist to a lesser degree, in the lower Willamette and may still periodically pose problems to fish passage (ODFW 1990b; Fuhrer et al. 1996). Fish tissue samples taken recently from the mainstem Willamette River have been found to have elevated levels of mercury, particularly in the industrial harbor of Portland (WRBTF 1997).

Agriculture is a significant land use throughout the basin above Willamette Falls that has adversely affected water quality. Associated nonpoint sources (e.g., nutrients, fertilizers, and pesticides) and physical habitat degradation (e.g., increased sedimentation, removal of riparian vegetation, channel bank protection works) have likely been detrimental to fish. Water withdrawal for irrigation and municipal purposes exacerbates naturally occurring summer low flow conditions in tributaries, leading to increased pollutant concentrations and higher water temperatures (ODFW 1990b; Fuhrer et al. 1996).

Approximately 13.5 miles of banks between the Yamhill River and Albany are eroding at rates classified as moderate or severe. This is due in part from removal of riparian vegetation by agriculture. Agricultural lands upstream of Salem are estimated to contribute 22 percent of the total annual sediment production of the basin (ODFW 1990b). Channelization and bank revetment of the river has been the primary solution, resulting in decreased fish habitat (ODFW 1990b). An estimated 75 percent of the original shoreline of the Willamette River has been lost to channelization, which has contributed to the loss of fish habitat through sedimentation, loss of spawning gravel, and loss of winter refugia (USGS 1997).

Cumulative effects appear to be greatest in low flow years. In addition to power water quality, there is evidence that passage survival of downstream migrant juvenile salmonids is reduced at Willamette Falls hydroelectric facilities (ODFW 1998).

7.2 NON-FEDERAL ACTIVITIES AND CUMULATIVE EFFECTS INFLUENCING LISTED SPECIES IN THE SANTIAM RIVER SUBBASIN

Timber harvest is the most significant land use upstream of the Willamette Project dams, and has had a significant influence on fish populations and habitat in the Santiam River subbasin (McIntosh et al. 1995; PNERC 1998). Skeesick and Jones (1988) reported “serious bedload, erosion, and siltation problems” in the Breitenbush River, a tributary to the North Santiam River,

that were caused by timber harvest. Harvest in riparian zones has resulted in decreased delivery of large woody debris to the river system. ODFW (1990c) reported that large woody debris was in short supply in most streams in the Willamette National Forest, which has been associated with reduced instream cover, loss of pool habitat, reduced storage of gravel, and loss of hydraulic complexity (Spence et al. 1996).

Agriculture is the predominant land use below the Willamette Project dams (PNERC 1998). Numerous unscreened diversion ditches in the lower reaches of the subbasin below the Willamette Project dams are associated with the loss of migrating salmon and steelhead smolts. Water diversion for municipal, agricultural and industrial needs have historically and presently contributed to summer water temperature problems in the Santiam River (ODFW 1990c; McIntosh et al. 1995).

Pollution historically influenced habitat quality within the Santiam River and the lower reaches of the North and South Santiam rivers. In the South Santiam River, sewage and pollutants including sulfites and other wastes from the Lebanon pulp and paper mills were determined to be present at levels lethal to fish in the early 1940s. The North Santiam River had large amounts of garbage and refuse disposed of in the river, including dye stuffs (from a wool mill) and raw sewage (McIntosh et al. 1995). Presently, much of the lower Santiam River subbasin experiences moderate to severe water quality problems in the form of low dissolved oxygen concentrations and high levels of toxins and fine sediments (ODEQ 1999 303(d) list).

7.3 NON-FEDERAL ACTIVITIES AND CUMULATIVE EFFECTS INFLUENCING LISTED SPECIES IN THE MCKENZIE RIVER SUBBASIN

Timber harvest is the predominant land use in the McKenzie River subbasin (PNERC 1998). Steep slopes, heavy rainfall, and unstable soils have contributed to increased frequencies and magnitudes of landslides and debris torrents in many portions of the McKenzie River subbasin. Timber harvest and road construction may have increased the frequency and magnitude of these events in the subbasin (ODFW 1990e). Debris torrents have scoured out some smaller, higher elevation streams, and increased fine sediment levels in stream gravels downstream, resulting in reduced fish production (USFS 1994; Spence et al. 1996). The Blue River, a tributary to the McKenzie River, and its tributaries appear to have experiencing instream temperature increases in areas adjacent to clearcuts, where streamside shade is deficient (Skeesick and Jones 1988).

7.4 NON-FEDERAL ACTIVITIES AND CUMULATIVE EFFECTS INFLUENCING LISTED SPECIES IN THE MIDDLE FORK WILLAMETTE RIVER SUBBASIN

Timber harvest is the predominant land use in the Middle Fork Willamette River subbasin (PNERC 1998). Timber harvest in riparian zones has resulted in increased summer stream temperatures in many tributaries to the Middle Fork Willamette River through removal of streamside shading (ODFW 1990f). Timber harvest has historically influenced landsliding activity in the upper Middle Fork Willamette River basin above Hills Creek Reservoir (Lyons and Beschta 1983). Historically, timber mills had constructed diversion structures that blocked or hindered upstream passage of listed salmonids and diverted juvenile fish moving downstream (Willis et al. 1960).

Water quality problems were more prevalent historically than presently in the subbasin. City sewage from Eugene flowed historically into the Middle Fork Willamette River, causing water quality problems during low flow periods (McIntosh et al. 1995). Lost Creek, a 17 mile long tributary to the Middle Willamette, had three sawmills producing sawdust, bark and slash pollution in the creek at the time of surveying in the early 1940s by the USFWS (McIntosh et al. 1995). The Clean Water Act has resulted in the correction or elimination of these and other problems, and conditions have improved considerably.

7.5 NON-FEDERAL ACTIVITIES AND CUMULATIVE EFFECTS INFLUENCING LISTED SPECIES IN THE COAST FORK WILLAMETTE RIVER SUBBASIN

The Coast Fork Willamette River subbasin has experienced a wider variety of land uses than the other subbasins draining the western slopes of the Cascade Range, that have contributed towards the depletion of historic fish runs prior to construction of Cottage Grove and Dorena dams (Fulton 1968; ODFW 1990d). Timber harvest activity has been extensive throughout the subbasin and has significantly affected future large woody debris sources and current fish production (ODFW 1990d). The upper subbasin experiences hard rock mining activity, with associated heavy metal pollution occurring in streams that could be used by listed fish species. Water quality has been historically poor: high bacterial counts and periodic low dissolved oxygen levels have been reported causing the Department of Environmental Quality to list the Coast Fork Willamette as “water quality limited” as recently as the late 1980s (ODFW 1990d). The Coast Fork Willamette River mainstem below Cottage Grove is currently listed on the 1999 State 303(d) list as being water quality impaired because of exceedances of ambient water quality criteria (AWQC).

Lumber mills have been a historic source of adverse effects to listed fish species. Several mill pond dams obstructed the Coast Fork Willamette River above the town of Cottage Grove, in some cases forming impassable barriers (McIntosh et al. 1995). Mill sawdust and sewage effluent of Cottage Grove were distinct sources of pollution in the Coast Fork during the 1930s and 1940s (McIntosh et al. 1995). Lumber mills are present today that remain as potential sources of pollution (ODFW 1990d).

7.6 NON-FEDERAL ACTIVITIES AND CUMULATIVE EFFECTS INFLUENCING LISTED SPECIES IN THE LONG TOM RIVER SUBBASIN

The Long Tom River was described by Wentz et al. (1998) as being highly impaired in terms of aquatic ecosystem health. A major factor adversely affecting native fish habitat in the Long Tom River below Fern Ridge Dam is high water temperatures, due in part to water withdrawals for municipal or agricultural uses. Agriculture is the dominant land use in the subbasin, and has resulted in the loss of riparian vegetation and bank habitat throughout the subbasin. Water withdrawal for irrigation also has adversely affected fish habitat quantity. The majority of the river, from its mouth to below Fern Ridge Dam, has been modified in relation to irrigation and drainage projects (ODFW 1990d).

Urbanization and related development along the upper reaches of Amazon Creek has adversely affected fish production by increasing peak flows, channel erosion, landslides, and pollution levels. Fecal coliform and turbidity levels have been determined on occasion to exceed acute water quality criteria in Amazon and Coyote creeks and affect downstream water quality. In addition, two recent chemical spills in Amazon Creek have caused major fish kills in the stream (ODFW 1990d). Portions of the Long Tom River and Amazon Creek are listed on the 1999 State 303(d) list as being water quality impaired because of low dissolved oxygen levels.

7.7 CUMULATIVE EFFECTS RELATED TO WATER QUALITY

Water quality degradation has occurred throughout the Willamette River basin as a result of human development, which have likely resulted in significant cumulative effects to listed fish species. There are several large scale studies underway to characterize the water quality problems in the basin. The two most important ones are the National Water Quality Assessment Study (Wentz and McKenzie, 1991) and a joint study being conducted by the ODEQ and USGS, which began in 1991.

NAWQA Study

The NAWQA study has entailed collecting and analyzing water quality data from instream water, streambed sediments, and aquatic biological tissues throughout the basin. Ecological and habitat characterization also has been completed. Groundwater has been sampled and analyzed from 70 shallow wells. Ten wells were also drilled and sampled in the Portland area to characterize the effects of urban land use on ground-water quality. The NAWQA study determined that fish communities and habitat have been affected adversely in streams draining urban and agricultural areas. Erosion was determined to have increased downstream of dams in association with various land use and water management practices. Eutrophication was noted to have occurred in many portions of the basin because of phosphorus and nitrogen loading from fertilizer applications. The study also determined that there is a large presence of PCBs, organochlorine pesticides, and trace elements in bed sediment and aquatic biota, and water quality degradation has occurred in the form of nutrients, trace organic compounds, pesticides and volatile organic compounds, in both surface and groundwater. Fifty pesticides were detected in streams, and 10 pesticides exceeded USEPA freshwater aquatic chronic toxicity criteria. Roughly twice as many pesticides and the highest pesticide concentrations were detected in streams draining predominantly agricultural land, than those streams draining mostly urban areas. The highest concentrations of cadmium, lead, silver, and zinc in bed sediment were found in urban streams, while the highest mercury concentrations in bed sediment were downstream from an abandoned mercury mine in the Coast Fork Willamette River.

The NAWQA study also evaluated the habitats and conditions of various fish communities. Pollution-sensitive fish were generally native species, such as cutthroat trout and torrent sculpin, and were found predominantly in forested streams. These fish were determined to be free from external anomalies that might be associated with poor water quality. Pollution-tolerant fish were generally introduced species, such as carp and bullheads, and occurred primarily in streams with few riffles, poor quality riparian habitat, and high water temperatures. External anomalies were most abundant on fish from these streams. Pollution-tolerant native fish, including minnows and reticulate sculpin, were found mostly in streams that drained agricultural and urban areas and contained the highest nutrient and pesticide concentrations. External anomalies were moderately high on fish from these streams. Relative abundances of fish were generally not highly correlated with water chemistry, however.

ODEQ/USGS Water Quality Study

The joint ODEQ/USGS study consists of two phases. The first phase has been completed and involved creating precipitation-runoff and streamflow models of the entire basin, collecting and analyzing suspended-sediment data, and initiating a sampling program for trace elements and organic contaminants. The second phase involves identifying the major sources of pesticides and trace elements in the basin, quantifying the depletion of dissolved oxygen associated with bed-sediment oxygen demand, and identifying the processes controlling dissolved oxygen concentrations upstream from Salem.

To date, the DEQ/USGS study has identified several major water quality problems within the Willamette River basin, including: dissolved oxygen levels; toxics, including pesticides, heavy metals and dioxins; point sources of wastewater; nonpoint sources of agricultural and urban runoff; and bacteria introduced from sewage bypasses and overflows, and agricultural sources. Preliminary findings have indicated that approximately 70 to 80 percent of water pollution in the basin is a result of nonpoint sources including particularly agricultural sources, and about 90 percent of the nonpoint source discharge occurs during the rainy season. It was also determined that the water quality and biological health of the mainstem Willamette River deteriorates in the downstream direction. Dye tracer studies have identified a large volume and seasonal variability of subsurface flow from groundwater occurring across the streambed interface.